

Installation, Operation & Maintenance Guide

EXHAUST GAS HEAT EXCHANGERS



BOWMAN[®]
100 YEARS OF HEAT TRANSFER TECHNOLOGY

Contents

Foreword	2	4. Commissioning	6
1. Safety		5. Maintenance / Repair	
1.1 Hazards when handling the heat exchanger	3	5.1 General maintenance	7
1.2 Safety instructions	3	5.2 Exhaust gas heat exchanger cleaning	7
1.3 Approved use	3	6. Warranty	8
1.4 Potential hazards	4	7. Performance	8
1.5 Safety measures at installation site	4	8. Spare Parts List	9
2. Installation		8.1 Straight end covers or no end covers	9
2.1 Transport / storage	4	8.2 Right angle end covers	10
2.2 Installation	5	9. Notes	11
2.3 Connecting the heat exchanger	6		
3. Operation	6		

Foreword

Bowman Exhaust Gas Heat Exchangers are precision precision-engineered, designed to recover waste heat energy from the exhaust stream of a stationary engine powered generator, pump or similar equipment.

They are designed to operate with the high temperatures generated in the engines' exhaust system, but in order for your heat exchanger to operate efficiently and reliably, it is important to carefully read the instructions in this 'Installation, Operation & Maintenance Guide' fully prior to installation and commissioning.

Please keep this guide for future reference to ensure the long-term performance of your Bowman Exhaust Gas Heat Exchanger.

Should you require additional advice or practical assistance, please contact your nearest stockist or dealer, who can be found on our web site: www.ej-bowman.com.

1. Safety

1.1 Hazards When Handling the Heat Exchanger

Bowman Exhaust Gas Heat Exchangers are constructed with current practice and recognised safety rules. Hazards may still arise from operation, such as:

- Injury of the operator or
- Third parties or
- Damage to the heat exchanger or
- Damage to property and equipment

Any person involved with the installation, commissioning, operation, maintenance or repair of the heat exchanger must:

- Be physically and mentally capable of performing such work
- Be appropriately qualified
- Comply completely with the installation instructions

The heat exchanger must only be used for its intended use.

In the event of breakdowns which may compromise safety, a qualified technician must always be contacted.

1.2 Safety Instructions

The following symbols are used in these operating instructions:



Danger

This symbol indicates an **immediate danger** to health. Failure to comply with this instruction may result in severe injury.



Caution

This symbol indicates a **possible danger** to health. Failure to comply with this instruction may result in severe injury.



Take Care

This symbol indicates a **possible risk** to health. Failure to comply with this instruction may result in injury or damage to property.



This symbol indicates important information about correct handling of the equipment. Failure to comply with this instruction may cause damage to the heat exchanger and/or its surroundings.

1.3 Approved Use



Bowman Exhaust Gas Heat Exchangers are only approved for reclaiming heat from waste heat exhaust gases.

Any other use unless specified by Bowman is not approved.

Bowman declines all liability for damage associated or arising from such use:

The maximum permissible operating pressures must not exceed:

Gas (tube side): 0.5 bar max.

Water (shell side): 4.0 bar max.

The maximum permissible operating temperatures must not exceed:

Gas (tube side): 700°C

Water (shell side): 110°C

European Pressure Equipment Directive

This range of products fall within Article 3 Paragraph 3 (Sound Engineering Practice) and do not require CE marking.

1.4 Potential Hazards

The heat exchanger may be damaged or leak, if the maximum permissible operating pressure is exceeded.

Connections on the exhaust gas side of the heat exchanger may reach temperatures as high as 700°C.

Connections on the water side of the heat exchanger may reach temperatures as high as 110°C.

1.5 Safety Measures at Installation Site

The heat exchanger should not be used without sufficient cooling water flow through the shell side.

Ensure the maximum permissible operating pressure of the heat exchanger is not exceeded. The heat exchanger or surrounding equipment may be damaged.

When the system is in operation, a weekly inspection of the heat exchanger and its connections should be made for leaks and externally visible damage.



2. Installation

2.1 Transport / storage

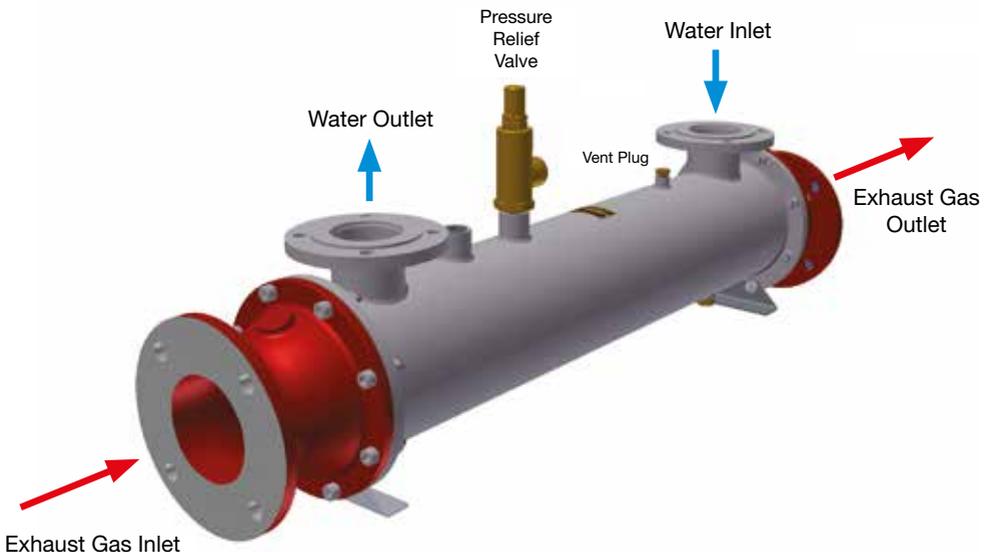
The heat exchanger must be drained prior to transportation. Once drained and dry, the heat exchanger must only be stored indoors in a non-aggressive atmosphere.

2.2 Installation



Before fitting, check the heat exchanger for visible signs of damage.

- a) The heat exchanger must be installed horizontally and levelled accurately, with the exhaust gas through the tubes and the water circuit over the tubes. The heat exchanger should be connected in 'counter flow' with the water circuit connections always being positioned on top (see schematic drawing below). Alternative installations may also be acceptable; consultation with Bowman should be made before installation.
- b) The heat exchanger should be installed below the level of the cylinder head, so that in the unlikely event of a tube leak occurring, water will not leak back into the engine.
- c) It is important that the water circuit is ventilated via the vent plug fitted in order to prevent the possibility of air pockets being present or aeration taking place, which can cause erosion.
- d) If ethylene glycol, or any other cooling medium is used, the correct concentration as advised by the engine manufacturer, should be mixed prior to filling the heat exchanger.
- e) If temperature control sensors are fitted to either circuits of the heat exchanger, they should be fitted to the inlet and not the outlet in order to provide accurate temperature readings.
- f) Under no circumstances should the pressure relief valve be removed or tampered with.
- g) Water must always be flowing through the heat exchanger when the engine is running.
- h) No valves are to be incorporated in the circuit, which could be accidentally turned off and prevent water flowing through the heat exchanger.
- i) The inlet and exit exhaust pipe bore must not be smaller than the heat exchanger connections.
- j) Automatic engine shutdown equipment must be fitted with temperature probes in the exhaust gas heat exchanger and the engine.





Take Care

2.3 Connecting the Heat Exchanger

Ensure compliance with water quality and maximum permissible pressure requirements.

When fitting the heat exchanger into the pipework, care must be taken to ensure that no debris has been introduced into the heat exchanger.

See exhaust gas heat exchanger brochure pages 6-8 for connection details of each model. Copies can be downloaded from: www.ej-bowman.com/downloads/

3. Operation



Take Care

It is essential that the following instructions are followed to prevent corrosion/erosion of the heat exchanger:

- a) Adequate provision should be made to ensure that in the event of the engine being shut down, the water circuit continues to operate for a period of time to enable the dispersal of residual heat to an acceptable level, preventing damage to the heat exchanger.
- b) Adequate provision should also be made to ensure that the water circuit pumps are in continual operation whenever the engine is in operation.
- c) Provision should also be made to ensure that any valves or ancillary equipment associated with either side of the heat exchanger cannot be accidentally turned off, thereby preventing flow through the heat exchanger.
- d) It is very important that the water circuit is fully vented via the vent plug fitted in order to prevent any aeration taking place which can cause erosion of the tubes.
- e)

Maximum working gas side pressure	0.5 bar
Maximum working water side pressure	4.0 bar
Maximum working gas side temperature	700°C
Maximum working water side temperature	110°C
- f) Bowman Exhaust Gas Heat Exchangers are designed for engine applications to be run in 'steady state' operating mode. It is not recommended to install the heat exchanger on engines that run in 'transient cycle' operating mode, as the constant thermal variation can create stresses within the structure, leading to premature failure.

4. Commissioning



Caution

Commissioning of the heat exchanger should not be undertaken until such time that this document has been fully read and understood.



Take Care

Adequate provision should be made to ensure that correct operating/service equipment along with personal protection equipment (PPE) in accordance with current standards/legislation is utilised prior to the commencement of any working.

5. Maintenance / Repair



5.1 General Maintenance

The heat exchanger should require little attention in service. However, when cleaning the tube stack, the notes given in 5.2 should be used as a guide. Note: new gaskets will be required, if the end covers or access plates are removed.

We recommend, in the first few months of installation, to regularly check for any build-up of deposits and monitor any pressure loss and/or performance drop on the exhaust side. In the case of increased pressure loss or performance drop, cleaning the tube plates needs to be performed on the heat exchanger. Please keep an operation and maintenance log of the work carried out. This procedure should be repeated every 6 months on both the exhaust gas and water side of the heat exchanger to maximise longevity.



5.2 Exhaust Gas Heat Exchanger Cleaning

We strongly recommend that mechanical and chemical cleaning of the exhaust gas heat exchanger is only carried out by specialised companies. However, the following guidelines may be useful, if cleaning is to be carried out by the user/operator:

- a) Removal of the end covers or access plates, depending on version, allows access to the tube plates.
- b) Wash the tube plates and tubes using a handheld hose or lance. An industrial steam cleaner can be used, if available.
- c) Tube brushes can be used to clean through each tube to aid in removing stubborn deposits. Small diameter rods and brushes for tube cleaning are available from companies such as Rico Industrial Services www.ricoservices.co.uk.
- d) Detergents or chemicals suitable for use with stainless steels can be used, if fouling is severe. Allow time for the detergent or chemical cleaner to work before hosing down with plenty of water.
- e) The tube stack should be flushed through with clean water to remove all traces of cleaning chemicals/detergents. If necessary, the cleaning fluid should be neutralised.
- f) End covers or access plates should be refitted after cleaning using new gaskets.

6. Warranty

All Bowman Exhaust Gas Heat Exchangers are guaranteed against manufacturing faults associated with the product for a period of twelve months from the date of invoice.

For full warranty terms, please see the Bowman Conditions of Sale, a copy of which which is available on request or via download from the website.

7. Performance

Typical examples of exhaust gas heat exchanger performance. The figures below are a general guide only and are not based on any particular natural gas engine. They assume an air/fuel ratio of 10.23 : 1 by volume, a fuel consumption of 0.34m³/kWh (measured at 1.013 bar and 15°C), an exhaust gas temperature of 600°C and a water temperature of 80°C.

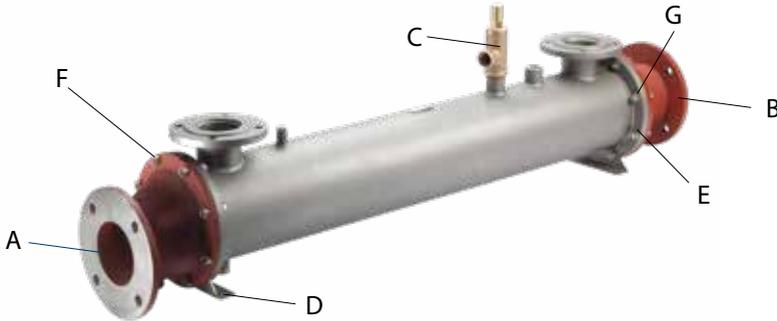
Figures are based on new and clean conditions.

Type	Typical Engine Power kW	Exhaust Gas Flow kg/min	Exhaust Gas Outlet Temp °C	Heat Recovery kW	Exhaust Gas Pressure Drop kPa
2-25-3737-4	16	1.2	210	9.5	1.6
2-32-3737-5	16	1.2	170	11.5	1.8
3-32-3738-5	32	2.4	198	19	1.2
3-40-3738-6	32	2.4	163	21	1.3
3-60-3738-8	32	2.4	116	23	1.6
4-32-3739-5	60	4.5	199	36	1.0
4-40-3739-6	60	4.5	164	39	1.2
4-60-3739-8	60	4.5	116	43	1.4
5-32-3740-5	90	6.7	195	55	1.0
5-40-3740-6	90	6.7	161	59	1.1
5-60-3740-8	90	6.7	115	65	1.4
6-32-3741-5	140	10.5	197	85	1.0
6-40-3741-6	140	10.5	163	92	1.2
6-60-3741-8	140	10.5	117	101	1.4
8-32-3742-5	250	18.7	199	151	1.0
8-40-3742-6	250	18.7	164	163	1.2
8-60-3742-8	250	18.7	117	180	1.4
10-32-3743-5	400	30.0	200	241	1.1
10-40-3743-6	400	30.0	164	262	1.2
10-60-3743-8	400	30.0	116	289	1.4
12-32-3744-5	600	45.0	199	362	1.1
12-40-3744-6	600	45.0	164	392	1.2
12-60-3744-8	600	45.0	117	432	1.5
15-32-5745-5	950	70.0	200	563	1.0
15-40-5745-6	950	70.0	165	610	1.1
15-60-5745-8	950	70.0	116	673	1.4

8. Spare Parts List

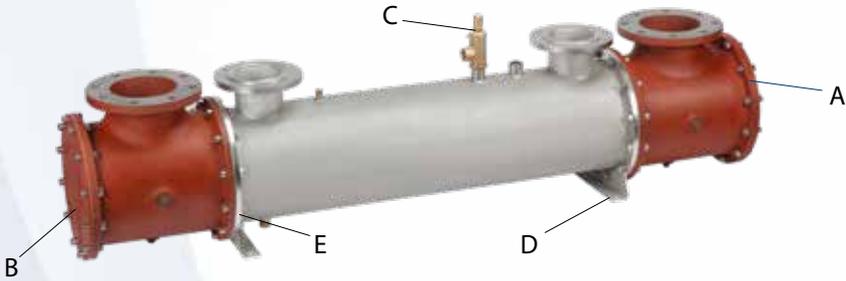
A complete range of replacement parts is available for all models.

8.1 Exhaust Gas Heat Exchangers - with straight end covers or without end covers



Type	Inlet End Cover A	Outlet End Cover B	Pressure Relief Valve C	Mounting Foot D	End Cover Gasket E	Socket Screw/ Nut* (F/G)
2-3737	EX2-3757CI	EX32-4057CI	4028	4476	3787	HS08X35SS / HN08A4
3-3738	EX3-3758CI	EX33-4058CI	4028	4477	3788	HS08X35SS / HN08A4
4-3739	EX4-3759CI	EX34-4059CI	4028	4478	3789	HS08X35SS / HN08A4
5-3740	EX5-3760CI	EX35-4060CI	3795	4479	3790	HS10X40SS / HN10SS
6-3741	EX6-3761CI	EX36-4061CI	3795	4480	3791	HS10X40SS / HN10SS
8-3742	EX8-3762CI	EX38-4062CI	3795	4481	3792	HS12X45SS / HN12A4
10-3743	EX10-3763CI	EX40-4063CI	3795	4482	3793	HS12X45SS / HN12A4
12-3744	EX12-3902CI	EX42-4064CI	3795	4483	3862	HS16X55SS / HN16SS
15-5745	EX43-5757CI	EX44-5758CI	3795	4484	5759	HS16X65SS / HN16SS

8.2 Exhaust Gas Heat Exchangers - with right angle end covers



Type	*Inlet End Cover Kit A	*Outlet End Cover Kit B	Pressure Relief Valve C	Mounting Foot D	End Cover Gasket E
2-5837	5334F-RP	5334F-RP1	4028	4476	3787
3-5838	5335F-RP	5335F-RP1	4028	4477	3788
4-5839	EX64-5336CI-RP	EX64-5336CI-RP1	4028	4478	3789
5-5840	EX65-5337CI-RP	EX65-5337CI-RP1	3795	4479	3790
6-5841	EX66-4982CI-RP	EX66-4982CI-RP1	3795	4480	3791
8-5842	EX67-4984CI-RP	EX67-4984CI-RP1	3795	4481	3792
10-5843	EX68-4987CI-RP	EX68-4987CI-RP1	3795	4482	3793
12-5844	5338F-RP	5338F-RP1	3795	4483	3862
15-5845	5339F-RP	5339F-RP1	3795	4484	5759

* Parts Included In End Cover Kits:-

End Cover
Gas Turn Assembly (Inlet Only)
End Plate (Outlet Only)
Gasket (Two Off)
Socket Screws (Two Sets)
Nuts (Two Sets)
Drain Plug(s)

Bowman heat transfer solutions

Bowman heat exchangers and oil coolers can be found in Active Fire Protection Systems, Automotive Testing, Combined Heat & Power, Hydraulic Systems, Marine Engineering, plus Mining Equipment and Machinery, in a range that includes:



Exhaust Gas Heat Exchangers



Hydraulic Oil Coolers



Swimming Pool Heat Exchangers



Stainless Steel Heat Exchangers



Header Tank Heat Exchangers



Plate Heat Exchangers



Engine Oil Coolers



Transmission Oil Coolers

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